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Agronomic Performance of Selected Cultivars of Pearl Millet (*Pennisetum glaucum* L.R.Br.) and their Hybrids in North-Eastern Nigeria

[1]A.U. Izge, [2]A.M. Kadams and [2]A.A. Sajo
[1]Department of Crop Production, Faculty of Agriculture,
University of Maiduguri, P.M.B. 1069, Maiduguri, Borno State, Nigeria
[2]Department of Crop Production and Horticulture,
School of Agriculture and Agricultural Technology, Federal University of Technology,
Yola, P.M.B. 2076, Yola, Nigeria

Abstracts: Field experiments were carried out simultaneously during the rainy season of 2004 and 2005 at the Faculty of Agriculture Research Farm, University of Maiduguri and School of Agriculture and Agricultural Technology, Federal University of Technology, Yola Nigeria. The study evaluated the agronomic performance of pearl millet lines and their hybrids. The experiments consisted of 10 pearl millet lines and their 45 hybrids laid out in a Randomized Complete Block Design (RCBD) with three replications. The Analysis of Variance (ANOVA) revealed significant difference among the population of pearl millet evaluated. Differences were also statistically significant in years and locations for all the characters studied, implying that variation existed in years and locations of the study, confirming the difference existing in the two locations, which could be as result of differential rainfall pattern and soil type. The high level of variability existing among a particular population is desirable, because the amount of improvement that could be obtained by selection in crop plants is dependent on it. The mean performance of the parental lines and their hybrids relatively showed distinct agronomic superiority in most of the characters over others. The study recommends ACC-1022-1-2SPT, BONKOK-SHORT and IMV11-3-3 SPT as potentially early maturing lines. The study also recommends the hybrids, LCIC9702xLCIC9703-27, IMV11-3-3SPTxLCIC9702 and BONKOK-SHORTxIMV11-3-3SPT as potentially early maturing and suitable for regions with marginal rainfall, especially northeastern Nigeria. The study further recommends, the parental lines ACC-1022-2SPT, SOSAT-C88 and the hybrids, DMR22xLCIC9702 and DMR43xLCIC9702 for high production of total grain yield. These superior performing parental lines and their hybrids can be subjected to further selection for improved pearl millet crop in a breeding program.

Key words: Pearl millet, hybrids, agronomic superiority, selection, total grain yield

INTRODUCTION

Pearl millet (*Pennisetum glaucum* L.R.Br.) locally known, as gero in northern Nigeria belongs to the plant family gramineae and is an important crop of arid and semi-arid areas of Nigeria, where moisture among other problems has been a limiting factor for its optimal production. It has the potential of producing high total grain yield for the increasing population in this region under an ideal situation. Pearl millet is a nutritious crop, producing almost all the required nutrients needed by humans. Filardi *et al.* (2005) reported that pearl millet produces higher protein levels than maize and have approximately 85% of the energy content of maize.

To increase total grain yield in pearl millet in Nigeria it is necessary to develop high grain yielding pearl millet varieties that can be grown successfully in this area. Nwasike and Oyejola (1989) have studied the performance of different pearl millet varieties in Samaru, in north central Nigeria and found Ex-Benue and Ex-Borno to have given the highest grain yield among other varieties evaluated. Izge *et al.* (2005) reported pearl millet cultivars, SE2124 to have produced the highest grain yield, also in Samaru north central Nigeria. However, information on grain yields and yield components among the cultivated pearl millet varieties in north eastern Nigeria are either not available or scanty, despite the fact that pearl millet is a prominent cereal crop in this region, hence the need to

Corresponding Author: A.U. Izge, Department of Crop Production, Faculty of Agriculture, University of Maiduguri, P.M.B. 1069, Maiduguri, Borno State, Nigeria

select pearl millet cultivars that can produce well in this area. It is for this reason that this research was undertaken to evaluate the performance of different pearl millet cultivars and their hybrids based on their yield and yield characteristics in the Sudan and the northern guinea savanna agricultural zones of Nigeria (North-Eastern Nigeria), where pearl millet is a predominant crop.

MATERIALS AND METHODS

Field experiments were conducted simultaneously at two locations in northeastern Nigeria during the cropping seasons of 2004 and 2005. The first experiment was conducted at the University of Maiduguri (11°53' N, 13°16' E), Faculty of Agriculture, Research Farm in the Sudan savanna agricultural zone, while the second experiment was conducted at the Federal University of Technology Yola, (9° 8' N, 12° 16' E), in the northern guinea savanna agricultural zone of Nigeria. The Maiduguri location is relatively characterized by low rainfall (500-750 mm per annum), very low humidity and the soils are sandy in nature. The Yola location however, has more rainfall (650-900 mm per annum)and relatively higher humidity and the soils are sandy-loam and some time clay loam in nature depending on site. These two different environments represent the major pearl millet growing areas of Nigeria and indeed in the arid and semi-arid areas of Africa and Asia.

Ten cultivars of pearl millet were chosen based on their different morphological characteristics viz., ACC-1022-1-2SPT, BONKOK-SHORT, D2P29, DMR43, DMR22, EX-BORNO, IMV11-3-3SPT, LCIC9702 and LCIC9703-27 and there 45 hybrids were grown for evaluation in Maiduguri and Yola in 2004 and 2005. The 55 treatments were grown in a randomized complete block design with three replications. The plot size was a four 5 m rows spaced 75×50 cm.

Seeds after treatment with Apron Star WS (Metalaxyl) at the rate of 15 g a.i kg^{-1} of seeds were sown as a pinch and later thinned down to two plants per hill, two weeks after sowing. Compound fertilizer (NPK 27:10:10) at the rate of 600 kg ha^{-1} was applied in two split doses, one at planting and the other at three weeks after sowing. Weed control was done by hand using hoe. Harvesting was done manually using hoe and knife after the maturity of the plants.

Data collection was done on the net plot i.e. the two inner rows of each plot on the following characters according to Izge *et al.* (2005) and Nwasike *et al.* (1992). These characters are, days to 50% flowering, number of tillers per plant, number of leaves per plant, downy mildew incidence, plant height, panicle length, number of seeds per panicle, 1000-grain weight, threshing %, grain yield per plant and total grain yield per hectare.

The data collected were subjected to statistical analysis of variance (ANOVA) across locations and years combined based on a linear statistical model and LSD at 5 and 1% levels of probability separated the means.

RESULTS AND DISCUSSION

The analysis of variance (ANOVA) as shown in Table 1 indicated that the year source of variation was significant in all the characters evaluated, except in panicle length and 1000 grain weight. The location source of variation was also significant in all the characters except in downy mildew incidence and 1000 grain weight. This therefore, suggests that differences existed among

Table 1: General analysis of variance, showing sources of variation and mean squares for yield and yield traits in eleven pearl millet characteristics combined over locations and years

Sources of variation	df	Days to 50% flowering	No. of tillers/plant	No. of leaves/plant	Downy mildew incid (%)	Plant height (cm)
Year	1	22516.003**	70.568**	1104.001**	5281.044**	271444.928**
Location	1	1971.203**	7.521*	4320.608**	257.641	12714.681**
Rep (Location)	4	30.463	2.178*	83.979**	676.014**	4444.685**
Entr	54	81.708**	0.874**	49.541**	259.403**	4278.482**
Location x entr	54	20.672**	0.636**	25.661**	149.323**	1390.339**
Year x entr	54	13.754**	0.590**	14.271**	118.557**	962.615**
Location x year	1	1363.767**	0.54	10.447	282.72	50464.396**
Location x year x entr	54	13.168**	0.543	26.042**	92.772**	1126.817**
Error	976	6.421	0.296	11.1	49.851	431.453

Table 1: Continued

Sources of variation	Panicle length (cm)	Seeds/panicle	1000 grain weight (g)	Threshing (%)	Grain yield/plant (g)	Grain yield (kg ha^{-1})
Year	48.212	3762976*	6.647	6784.529**	2568.414**	4810663.57**
Location	961.713**	17056234**	11.886	53420.302**	36407.55**	1007486.78**
Rep (Location)	34.702	829676.7	14.287**	835.335**	703.34**	1106002.17**
Entr	422.048**	1983328.7**	11.636**	232.849**	268.263**	530271.4**
Location x entr	29.249**	724715.5**	6.12**	252.691**	196.095**	305915.25**
Year x entr	29.001**	671521.2**	5.075**	151.71*	169.039**	162900.23*
Location x year	289.767**	12457359.6**	6.319	33527.418**	19792.356**	20285414.34**
Location x year x entr	16.076	1182772.6**	5.958**	208.268**	187.025**	171225.96
Error	10.865	298436.5	2.485	73.89	75.778	89768.7

**Significant at 1% level of probability, *Significant at 5% level of probability the years and locations of the study. This could be so because Yola is located in the northern guinea savanna agricultural zone of Nigeria, while Maiduguri is located in the Sudan savanna. These two locations differ remarkably in their types of soils and in their rainfall pattern.

The analysis of variance also indicated highly significant difference among the entries in all the characters evaluated, implying the presence of tremendous levels of variability among the parental lines and their hybrids evaluated. Falconer (1989) and Izge *et al*. (2005), have reported similar results and found astounding levels of genetic variability among crop plants. The amount of improvement that can be obtained by selection in crop plants is always dependent on the amount of variation that exists in a population. Location xentry interaction and yearxentry interaction (Table 1) was significant or highly significant for all the characters evaluated. However, location × year interactions was not significant for number of tillers per plant, number of leaves per plant, downy mildew incidence and 1000 grain weight. Location × year × entry interactions was not significant for number of tillers per plant; panicle length and total grain yield per hectare. The significant level of location x entry interaction indicates that mean yield responses for the parents and their hybrids tended to be inconsistent across the locations. These suggest that more than one test locations are required to obtain reliable results. Therefore, results obtained from a given entry, year and location combinations are an expression of conditions manifest explicitly in that entry, year and location and interpretations should be made in that context.

The mean performances for parental per se performance and their eleven characters of pearl millet combined across locations and years are presented in Table 2. The relative performance of the parental lines and that of their hybrids clearly indicates the agronomic superiority of some of the parents and hybrids over others. The potential for early maturity exist in the parental lines and their hybrids, e.g., in, ACC-1022-1-2SPT, BONKOK-SHORT, IMV11-3-3SPT, LCIC9702x LCIC9703-27, BONKOK-SHORTxLCIC9702 and BONKOK-SHORTxLCIC9703-27. These hybrids could be subjected to further selection to obtain very early and extra early maturing varieties because, early maturing varieties are essential for successful production in areas with marginal rainfall.

The result indicated that number of leaves per plant ranged from 10.16 to 18.95. The potential for increased number of leaves per plant exist with the use of parental lines like SOSAT-C88, EX-BORNO and ACC-1022-1-2SPT to obtain a hybrid combination. These parental lines would be useful materials in areas where pearl millets are grown for forage.

Downy mildew is a widespread and destructive disease and a major factor limiting full exploitation of high yielding improved cultivars. The result indicated that D2P29, LCIC9702, BONKOK-SHORT and EX-BORNO could confer downy mildew tolerance in pearl millet because of their lower level of downy mildew incidence. This study identified the hybrids LCIC9703-27xSOSAT-C88, LCIC9702xSOSAT-C88 and BONKOK-SHORTx SOSAT-C88 as having good downy mildew tolerance. These crosses can further be subjected to more selection pressure to obtain downy mildew tolerant varieties.

Plant height of cultivars has been of paramount importance in the acceptance of a pearl millet variety in a local community. Ouendeba *et al*. (1993) reported that farmers in Senegal and Niger were not willing to accept dwarf pearl millet cultivars because they also need the longer pearl millet stalks for fencing, fueling and for building houses. This study identified DMR43, DMR22 and D2P29 as the tallest, where stalks after harvest can be used for fencing when building houses. However, because of the cropping seasons in the Sub-Saharan Africa and the Sahel which are characterized by strong winds and which causes heavy production losses due to lodging, medium plant height and strong stalk are more useful traits when dealing with lodging. This study identified parental lines with the potential for production of shorter plant stalks. Depending on the breeding objectives wide range of parents and hybrids exist to choose from. If the objective is to produce plant with shorter stalk, then selection of BONKOK-SHORT is advocated because it is the shortest parental line with large grain size. This study recommends BONKOK-SHORTx LCIC9702, as the best in that direction.

Panicle length and structure are also some of the important agronomic traits in the acceptance of variety by farmers in arid and semi-arid regions of Africa. Most pearl millet cultivars are characterized by short and compact panicles. This study found that BONKOK-SHORT has the shortest panicle among the parental lines and DMR22 as having the longest panicle. Good potentials also exist for DMR43x1MV11-3-3SPT, DMR43xLCIC9702, D2P29x DMR43 and DMR43xSOSAT-C88 for the production of longer panicle length. They can further be subjected to selection for improved panicle length. Ouendeba *et al*. (1996) reported that farmers were found to select their seeds based on spike length, spike compactness and seed size for subsequent planting.

The comparative performance of the parental lines and their hybrids also clearly portrayed the superiority of some of the parents and their hybrids over others in number of seeds per panicle. High potentials exist for parental lines like SOSAT-C88 and EX-BORNO in terms of number of seeds per panicle. Similarly, potential also exist for hybrids like DMR43xSOSAT-C88, D2P29xSOSAT-C88 and D2P29xIMV11-3-3SPT, which also had higher number of seeds per panicle.

This study found that parental lines producing higher grain mass incidentally recorded higher threshing percentage, which invariably translated in most cases to higher total grain yield. This result is in agreement with that of Dhillon *et al.* (1977) and Ouendeba *et al.* (1993).

Table 2: Mean performance of parental lines and their hybrids for eleven characters of pearl millet, combined across locations and years

Sr. No.	Parents/ Crosses	Parent/Hybrids	Days to 50% flowering	No. of tillers per plant	Number of leaves per plant	Downy mildew incidence (%)	Plant height (cm)	Panicle length (cm)
1	1	ACC-1022-1-2SPT	57.61	1.85	15.75	6.57	186.00	27.99
2	2	BONKOK SHORT	58.08	1.33	10.16	3.77	137.43	11.80
3	3	D2P29	61.17	1.42	13.42	1.15	186.36	31.93
4	4	DMR43	61.75	1.58	14.92	6.20	191.13	33.49
5	5	DMR22	60.58	1.50	13.75	12.25	187.57	34.26
6	6	EX-BORNO	62.25	1.58	15.92	6.00	177.71	29.40
7	7	IMV11-3-3SPT	58.92	1.33	14.42	10.88	166.98	25.27
8	8	LCIC9702	59.25	1.75	14.42	2.40	144.85	25.13
9	9	LCIC9703-27	60.58	1.67	14.67	9.88	178.73	24.63
10	10	SOSAT-C88	62.36	1.53	16.23	12.12	176.42	24.30
11	1x2	ACC-1022-1-2SPT x BONKOK SHORT	56.35	1.76	14.93	1.37	166.75	19.75
12	1x3	ACC-1022-1-2SPT x D2P29	58.94	1.79	15.99	3.00	194.14	31.99
13	1x4	ACC-1022-1-2SPT x DMR43	59.25	1.81	14.45	7.90	198.92	31.62
14	1x5	ACC-1022-1-2SPT x DMR22	60.31	1.72	17.27	4.00	196.55	29.92
15	1x6	ACC-1022-1-2SPT x EX-BORNO	57.83	1.98	14.16	1.57	189.32	27.52
16	1x7	ACC-1022-1-2SPT x IMV11-3-3SPT	58.25	1.87	14.83	2.59	194.60	28.50
17	1x8	ACC-1022-1-2SPT x LCIC9702	57.04	1.85	16.81	4.79	172.80	24.96
18	1x9	ACC-1022-1-2SPT x LCIC9703-27	58.94	1.81	12.80	2.59	184.56	26.22
19	1x10	ACC-1022-1-2SPT x SOSAT-C88	57.96	1.93	15.34	3.29	195.45	28.49
20	2x3	BONKOK SHORT x D2P29	56.44	1.82	15.94	2.09	179.34	20.10
21	2x4	BONKOK SHORT x DMR43	57.61	1.74	15.55	5.00	194.60	24.23
22	2x5	BONKOK SHORT x DMR22	56.90	1.91	15.88	9.24	194.27	20.91
23	2x6	BONKOK SHORT x EX-BORNO	53.48	1.79	16.84	4.48	192.60	18.70
24	2x7	BONKOK SHORT x IM11-3-3SPT	54.40	2.04	17.81	1.60	177.66	21.07
25	2x8	BONKOK SHORT x LCIC9702	53.61	1.73	13.87	8.56	166.58	21.49
26	2x9	BONKOK SHORT x LCIC9703-27	54.25	1.93	16.40	3.21	184.03	21.09
27	2x10	BONKOK SHORT x SOSAT-C88	57.06	2.03	18.11	0.44	196.85	22.31
28	3x4	D2P29 x DMR43	59.87	1.45	15.69	14.83	212.61	34.75
29	3x5	D2P29 x DMR22	61.42	1.09	15.35	9.47	206.66	30.45
30	3x6	D2P29 x EX-BORNO	58.41	1.56	14.05	8.12	201.06	31.10
31	3x7	D2P29 x IMV11-3-3SPT	59.16	1.17	13.12	13.40	199.99	32.62
32	3x8	D2P29 x LCIC9702	57.23	1.75	16.16	5.65	192.95	32.15
33	3x9	D2P29 x LCIC9703-27	57.42	1.64	15.84	9.09	208.75	32.37
34	3x10	D2P29 x SOSAT-C88	60.08	1.49	16.04	4.93	207.02	30.65
35	4x5	DMR43 x DMR22	59.59	1.94	18.47	7.32	183.52	34.66
36	4x6	DMR43 x EX-BORNO	59.85	2.51	18.34	4.73	208.96	31.66
37	4x7	DMR43 x IMV11-3-3SPT	60.65	1.51	15.26	0.63	198.88	37.47
38	4x8	DMR43 x LCIC9702	56.87	1.88	16.27	4.21	190.11	35.60
39	4x9	DMR43 x LCIC9703-27	56.65	2.09	16.71	10.69	207.09	30.34
40	4x10	DMR43 x SOSAT-C88	60.73	1.69	16.19	2.21	218.71	34.72
41	5x6	DMR22 x EX- BORNO	61.22	1.71	16.61	6.65	201.38	25.82
42	5x7	DMR22 x IMV11-3-3SPT	59.20	2.06	16.62	12.63	206.03	30.58
43	5x8	DMR22 x LCIC9702	57.84	1.76	15.63	5.30	207.81	28.21
44	5x9	DMR22 x LCIC9703-27	58.12	1.64	15.82	7.68	211.79	31.99
45	5x10	DMR22 x SOSAT-C88	60.09	1.91	12.87	3.31	191.85	30.47
46	6x7	EX-BORNO x IMV11-3-3SPT	57.35	2.16	18.22	11.64	185.72	26.00
47	6x8	EX-BORNO x LCIC9702	56.18	2.00	16.12	8.23	175.40	24.70
48	6x9	EX-BORNO x LCIC9703-27	57.42	1.62	13.50	8.65	202.43	27.07
49	6x10	EX-BORNO x SOSAT-C88	60.14	1.95	16.04	2.55	208.23	
50	7x8	IMV11-3-3SPT x LCIC9702	55.45	2.00	18.95	5.59	195.12	32.24
51	7x9	IMV11-3-3SPT x LCIC9703-27	57.08	1.98	14.81	6.03	184.36	28.59
52	7x10	IMV11-3-3SPT x SOSAT-C88	56.66	1.95	16.47	2.20	193.36	29.65
53	8x9	LCIC9702 x LCIC9703-27	53.67	2.02	16.57	8.05	182.17	26.35
54	8x10	LCIC9702 x SOSAT-C88	56.08	2.08	15.31	0.24	181.42	25.77
55	9x10	LCIC9703-27 x SOSAT-C88	58.00	2.30	17.39	0.06	199.11	26.45
		MEAN	58.32	1.80	15.74	5.26	189.57	27.91
		CV (%)	4.75	33.10	23.75	14.86	12.14	13.19
		SE	1.598	0.345	2.158	4.515	13.284	2.125

Table 2: Continued

Sr. No.	Parents/ Crosses	Parent/Hybrids	No. of seeds per panicle	1000-grain weight (g)	Threshing (%)	Grain yield/ plant (g)	Grain yield (kg ha^{-1})
1	1	ACC-1022-1-2SPT	1783.53	9.06	60.89	18.02	615.67
2	2	BONKOK SHORT	1056.75	10.53	63.29	12.87	255.44
3	3	D2P29	1878.75	8.68	55.42	14.35	413.46
4	4	DMR43	2159.33	8.05	58.14	14.34	463.21
5	5	DMR22	1895.08	8.47	57.00	11.40	470.92
6	6	EX-BORNO	2334.50	8.43	58.51	20.24	327.61
7	7	IMV11-3-3SPT	1922.42	7.93	60.94	11.09	451.41
8	8	LCIC9702	1721.00	8.67	65.73	11.92	418.69
9	9	LCIC9703-27	1690.92	8.70	55.82	13.11	453.67
10	10	SOSAT-C88	2614.37	8.52	62.78	16.49	479.86
11	1x2	ACC-1022-1-2SPT x BONKOK SHORT	2166.79	10.43	57.95	16.46	660.62
12	1x3	ACC-1022-1-2SPT x D2P29	2159.55	9.04	60.42	20.80	828.06
13	1x4	ACC-1022-1-2SPT x DMR43	2020.17	9.89	58.80	17.31	720.23
14	1x5	ACC-1022-1-2SPT x DMR22	1909.11	8.76	56.76	15.27	595.08
15	1x6	ACC-1022-1-2SPT x EX-BORNO	1750.49	9.71	55.26	20.86	697.87
16	1x7	ACC-1022-1-2SPT x IMV11-3-3SPT	1753.92	8.59	57.03	18.08	692.99
17	1x8	ACC-1022-1-2SPT x LCIC9702	1505.19	8.52	50.91	12.80	525.85
18	1x9	ACC-1022-1-2SPT x LCIC9703-27	1801.14	9.02	59.77	16.59	534.88
19	1x10	ACC-1022-1-2SPT x SOSAT-C88	1934.16	9.32	58.78	19.49	803.23
20	2x3	BONKOK SHORT x D2P29	1180.20	7.45	62.22	17.91	681.57
21	2x4	BONKOK SHORT x DMR43	1576.07	9.84	60.75	13.38	584.75
22	2x5	BONKOK SHORT x DMR22	1630.69	7.83	62.37	20.87	881.29
23	2x6	BONKOK SHORT x EX-BORNO	1212.57	8.41	63.51	17.67	688.76
24	2x7	BONKOK SHORT x IM11-3-3SPT	1455.92	7.01	59.70	18.58	839.85
25	2x8	BONKOK SHORT x LCIC9702	1352.10	7.76	65.64	13.15	614.89
26	2x9	BONKOK SHORT x LCIC9703-27	1234.32	7.05	62.51	12.78	663.19
27	2x10	BONKOK SHORT x SOSAT-C88	1586.92	7.45	56.68	24.07	925.08
28	3x4	D2P29 x DMR43	2331.13	9.78	63.42	19.90	1087.00
29	3x5	D2P29 x DMR22	2407.39	9.23	62.52	11.89	781.37
30	3x6	D2P29 x EX-BORNO	2443.86	9.61	63.99	18.10	922.46
31	3x7	D2P29 x IMV11-3-3SPT	2508.99	8.66	67.34	16.57	883.77
32	3x8	D2P29 x LCIC9702	2267.56	9.15	66.83	20.67	877.53
33	3x9	D2P29 x LCIC9703-27	1925.00	10.18	66.99	17.54	730.25
34	3x10	D2P29 x SOSAT-C88	2216.44	8.52	60.92	12.77	704.46
35	4x5	DMR43 x DMR22	2120.32	9.87	60.77	19.30	784.37
36	4x6	DMR43 x EX-BORNO	2225.14	9.98	53.80	28.59	914.27
37	4x7	DMR43 x IMV11-3-3SPT	2355.10	8.98	61.33	24.35	874.04
38	4x8	DMR43 x LCIC9702	2083.09	9.52	55.60	22.45	1006.80
39	4x9	DMR43 x LCIC9703-27	2057.26	9.39	59.54	22.30	684.07
40	4x10	DMR43 x SOSAT-C88	2813.86	9.24	57.54	20.80	909.38
41	5x6	DMR22 x EX- BORNO	2443.92	9.71	63.70	16.72	706.80
42	5x7	DMR22 x IMV11-3-3SPT	2039.18	8.71	52.98	20.98	824.09
43	5x8	DMR22 x LCIC9702	2415.67	9.00	60.56	22.88	1018.20
44	5x9	DMR22 x LCIC9703-27	2057.93	9.49	61.26	19.36	775.94
45	5x10	DMR22 x SOSAT-C88	2219.94	9.49	60.18	17.95	497.85
46	6x7	EX-BORNO x IMV11-3-3SPT	1933.78	9.56	54.82	17.73	899.67
47	6x8	EX-BORNO x LCIC9702	1847.88	9.63	57.19	14.82	782.00
48	6x9	EX-BORNO x LCIC9703-27	1848.09	9.35	56.56	13.09	629.95
49	6x10	EX-BORNO x SOSAT-C88	2553.85	9.15	56.75	16.91	818.06
50	7x8	IMV11-3-3SPT x LCIC9702	2169.57	8.93	64.55	25.14	725.44
51	7x9	IMV11-3-3SPT x LCIC9703-27	1909.11	8.05	56.54	15.29	503.48
52	7x10	IMV11-3-3SPT x SOSAT-C88	2320.21	8.88	59.53	24.85	889.29
53	8x9	LCIC9702 x LCIC9703-27	1694.67	10.35	62.38	20.61	770.51
54	8x10	LCIC9702 x SOSAT-C88	2443.61	9.29	64.32	21.88	893.56
55	9x10	LCIC9703-27 x SOSAT-C88	2229.21	9.09	63.66	23.13	759.58
		Mean	2011.67	9.14	60.25	18.27	699.94
		CV (%)	32.33	18.37	15.89	53.29	46.27
		SE	375.546	0.969	5.527	5.622	186.98

This study therefore, identified BONKOK-SHORT, ACC-1022-1-2SPT and LCIC9702 as the best in terms of seed mass. While LCIC9702, BONKOK-SHORT, SOSAT-C88 and ACC-1022-1-2SPT were identified as having the highest shelling percentages. Similarly, the hybrids D2P29 xIMV11-3-3SPT, D2P29xLCIC9703-27 and D2P29x LCIC9702 were identified as having produced the highest grain mass.

The total grain yield varied considerably among the parental lines and their hybrids in this study. Gravois (1994) reported similar results in rice and in maize by Nevado and Cross, (1990). Identification of high yielding hybrids of pearl millet is helpful, because approximately one third of the world's pearl millet are grown in Africa and 70 % of that is in arid and semi-arid regions of this great continent (Kumar, 1989). This study also identified the hybrids D2P29xDMR43, DMR22xLCIC9702, DMR43x LCIC9702 and BONKOK-SHORT x SOSAT-C88 as having yielded higher total grain yield per hectare. These hybrids could further be subjected to selection to obtain high yielding varieties, because pearl millet cultivars grown by farmers are still producing lower total grain yield compared to other cereals. In most cases, the performances of the hybrids have been found to be greater than those of the parental lines. This could be as a result of hybrid vigor existing among the hybrids.

The study ultimately recommends that the parental lines and the hybrids that performed very well in the agronomic characters evaluated could be used and incorporated in to a future-breeding program.

CONCLUSIONS

Differential performances in yield of crop plants are usually associated with their yield traits and the interactive effects of environmental factors. The results show variation among the parental lines and the hybrids in their agronomic yield and yield traits evaluated. Depending on the breeding objective and the farmer's preference a range of parents and hybrids exist to choose from.

Generally the performances of the hybrids were better compared to the parental lines. Pearl millet parental lines or hybrids that possesses characteristics like; earliness, downy mildew tolerance, tallness of plant stalk and high grain yielding ability will be desirable. This is because rainfall in part of northeastern Nigeria is in short duration, where early maturing crop will be of advantage in escaping drought situations. Downy mildew tolerant pearl millet varieties are also desirable in reducing the production costs and enhance total grain yield. Equally tall pearl millet plants are of importance, because the stalks after harvest are used in the fencing of houses and for thatching in addition to the grain that are obtained from them.

The study therefore recommends the parental lines and hybrids that excelled in the characters of interest. The study recommends the hybrids; LCIC9702 x LCIC9703-27, BONKOK-SHORT x LCIC9702 and BONKOK-SHORTx LCIC9703-27 when selecting for early maturity potentials. The study equally recommends the hybrids LCIC9703-27 x SOSAT-C88, LCIC9702 x SOSAT-C88and BONKOK-SHORT x SOSAT-C88 as the most tolerant when selecting for downy mildew resistance. Good potentials exist for the hybrids; D2P29xDMR43, DMR22xLCIC9702, DMR43x LCIC9702 and BONKOK-SHORTxSOSAT-C88 for the production of total grain yield.

These superior hybrids identified could further be subjected to more appropriate breeding methods and selection to obtain high yielding and promising varieties of pearl millet.

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